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RELATION BETWEEN THE ROOTS OF A RATIONAL INTEGRAL FUNCTION AND ITS DERIVATIVE.

By Frank Irwin.

In the number of the *Annals* for March, 1914, Hayashi gives a proof, the first, so far as known, not based on dynamical conceptions, of the proposition that if $f(z)$ be a polynomial, and $f'(z)$ its derivative, the roots of $f'(z) = 0$ lie in the complex plane within or on the boundary of the smallest convex polygon that contains all the roots of $f(z) = 0$. It may, however, be noted that the simple proof reproduced, for instance, in Osgood's *Funktionentheorie* (2d ed., p. 210), can readily be modified to avoid the use of the language of dynamics.

We are to consider the values of z that make $f'(z)/f(z)$, that is

$$\frac{1}{z - z_1} + \cdots + \frac{1}{z - z_n},$$

vanish, $z_1, \cdots z_n$ being the roots of $f(z) = 0$; or, what is the same thing, that make

$$\frac{1}{\bar{z} - \bar{z}_1} + \cdots + \frac{1}{\bar{z} - \bar{z}_n}$$

vanish, where $z, \bar{z}_1, \cdots$ are the conjugates of $z, z_1, \cdots$. Now the vector $1/(\bar{z} - \bar{z}_i)$ has the same direction as $z - z_i$. If then z lie outside the polygon referred to in the enunciation of the proposition, say on the other, the outer side of the side AB of that polygon, each of the vectors $1/(\bar{z} - \bar{z}_1), \cdots, 1/(z - \bar{z}_n)$, will be directed from inside the polygon, across AB, to outside the polygon, in other words their components perpendicular to AB will all have the same sense (and none of them will be zero); and the sum of these vectors cannot, therefore, be zero.

Berkeley, California,
October, 1914.

ERRATUM.

Volume 16.

Some remarks on conformal representation. By T. H. Gronwall.
Page 75, line 10, read $\pi\left(\frac{1}{r^2} - \sum_{n=1}^{\infty} n\,|\,a_n\,|^2 r^{2n}\right)$ instead of $\pi\left(1 - \sum_{=1}^{\infty} n\,|\,a_n\,|^2 r^{2n}\right)$.